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**Abstract**
Laffer curve is a trade-off between tax cuts and tax revenues. The study implies threshold regression to test the existence of the Laffer curve in Pakistan’s economy using time series data for a period of thirty years (1991-2020). The linear association between tax cuts and tax revenues was assessed using simple ordinary least squares technique. The tax structure of Pakistan mainly constitutes two components, direct and indirect taxes. This study examined nature of the Laffer curve using data on direct tax revenue and corporate tax rate. The study supported the evidence of the Laffer curve with a threshold tax rate of 26%. The existing corporate income tax rate in Pakistan is 29% which lies in prohibitive range of the Laffer curve. As a policy measure, the corporate tax rate is recommended to be reduced at least up to the threshold level in order to bring the maximum number of tax evaders and elites under the tax net to enhance the tax revenues of Pakistan.

**Introduction**
The Laffer curve is basically a theoretical association between tax rates and the consequent amounts of tax revenues received by the government (Fullerton, 1983; Latif et al., 2019). The theory of the Laffer curve was developed by the supply-side economist Arthur Laffer in 1974. It assumes zero tax revenue generated at the extrema of tax rates (Bender, 1984). The Laffer curve is normally illustrated as a graph that initiates from 0% tax rate with no tax revenue, increases to a maximum level of tax revenue at a midway tax rate, and then drops down to zero tax revenue at a 100% tax rate. However, the economists differ in their views about the shape of Laffer curve which is controversial and uncertain among them (Tucker, 2010). The Laffer curve follows Rolle’s theorem as it is assumed that revenue is the continuous function of the tax rate (Gahvari, 1989; Meyer, 2012).

The literature largely supports the concept of Laffer curve which describes that the tax revenues can be boosted up through tax cuts (Smith, 1776; Talâts and Papp, 2008; Bunescu and Comaniciu, 2013; Holter et al., 2014; Tatu, 2014; Isakov and Pekarski, 2015). But, the rise in tax revenues due to a fall in tax rates is limited up to a certain level of tax rate or upper fiscal limit. If the tax rates are above the specified limit, it implies that the economy is operating in the prohibitive area of the curve (De Oliveira and Costa, 2015). Laffer curve is more effective to raise the income as compared to progressive taxation (Holter et al., 2014). Hsing (1996) studied four different functional forms of Laffer curve for the U.S economy using annual data (1959-91) of personal income tax rate thereby specifying a quadratic function and found that linear and log-log regression functions showed better results than the semi-log functions.

Hairault et al. (2005) made use of Laffer curve to study the trade-off between incentives for delayed retirement and little increase in pension to mitigate the deficit using French data; and suggested that administration may encourage the employees to delay their retirements by offering attractive allowances or to set minimum amounts of pension after their retirements. Bachvarova (2008) analyzed the data of 127 small developing countries for the period of 1990-2005 and found that Laffer curve helped during debt pressure conditions because many small countries did not have many resources for investment. Moreover, the effect of Laffer curve was also distorted by the political instability in countries. Uhlig and Trabandt (2011) studied the Laffer curve for fifteen selected states of the European Union and concluded that tax cut could improve the tax revenue to the extent much greater than that in USA. Nutahara (2013) sketched the Laffer curve for Japan’s economy and recommended that government might follow the
strategy of Laffer to enhance the tax revenue by decreasing the
taxes on capital but increasing taxes in labour market. The
countries with high debt to GDP ratio, like Japan, are quite
suitable to increase the revenues by tax cuts.
Latif et al. (2019) proved the existence of Laffer curve on the
basis of taxes on goods and services for the period of 1981 to
2018 and concluded that existing tax rates were prevailing
within the prohibitive area of the curve in Pakistan. However,
some caveats exist in the study of Latif et al. (2019) wherein total
tax revenue (% of GDP) was used as dependent variable rather
than the revenue obtained from only indirect-taxes. On the other
side, tax amount on goods and services (% of total tax revenue)
was used as an explanatory variable rather than using the tax
rate levied on goods and services. The nature of variables chose
contradicted with the basic theory of Laffer curve.
Laffer curve, as a tool of taxation, helps in alleviating the fiscal
deficit (Tatu, 2014). The theory also holds at its best in
recession periods when economies need appropriate fiscal
policies to be cured (Isakov and Pekarski, 2015). Chakraborty
(2015) also asserted that the Laffer curve could serve as an
effective instrument to offload the fiscal deficits in developing
countries. Van Ravesteyn and Vlijhrief (1988) derived a Laffer
curve for Netherland’s economy and found that the increase in
tax revenue by enhancing tax rate incurs a welfare loss to the
economy.
The tax system of Pakistan is not as much efficient and effective
as that in developed economies (Latif et al, 2019). A number of
loopholes exist in the tax regime of Pakistan, which can be
treated to the great extent by employing the Laffer curve as a
revenue increasing tool. Every year, Pakistan faces a high
deficit to budget ratio at national as well as international levels
in terms of loans from foreign funding organizations (World
Bank and IMF, etc.) at high interest rates. It also averts the
attention of foreign investors to make investments in Pakistan.
Laffer curve may serve as a partial solution to the existing grim
situation through adjustment of tax rates in such a way that
maximum number of tax avoiders and elites could be brought
under the tax net. Lucas Jr (1990) supported the supply-side
economists and recommended to follow them in tax systems of
developing countries.
The paper in hand is aimed at studying the Laffer curve in the
context of Pakistan thereby depicting the relationship between
tax rates and resulting revenues received by the government.
The earlier literature lacks the estimation of Laffer curve in the
context of Pakistan particularly using the revenues received
from direct taxes and corporate income tax rates. The two basic
modules of Federal tax revenues are direct taxes (income tax
received from corporations and individuals and taxes on capital
dvalues) and indirect taxes (general sales tax, customs
and excise duties). Indirect taxes are considered to be
regressive in nature because their pressure is transmitted or
forwarded to the end consumers. The direct taxes, on the other
hand, are generally considered to be progressive and can help
upholding the overall proportionality of the tax systems. The
direct (or income) taxes have a vital role in sustainability of the
economic growth and development of an economy.
Historically, the direct tax remained a major contributor in
total tax revenues. According to the recent annual report of FBR
(2018-19) approximately, 38% of total tax revenue of Pakistan
is received from direct taxes. Moreover, corporate income
taxes have large share in the direct tax revenues. So, this study
focused the corporate sector of Pakistan’s economy and the
revenue maximizing corporate tax rate has been worked out
using threshold regression analysis.
The objectives of the study are: 1) to study the applicability of
Laffer curve in Pakistan, 2) to study the impact of tax cuts on
tax revenues in Pakistan, and 3) to work out the optimum level
of corporate tax rate in Pakistan using threshold regression
analysis. Rest of the paper is organized as follows: the second
section deals with methodology, followed by the third section
of results and discussion, and the fourth section concludes the
paper.

METHODOLOGY

Data
The study used time series secondary data for the period 1991-
2020 in order to achieve the research objectives. The data on
tax revenues, corporate tax rates and GDP were retrieved from
the Ministry of Finance, Government of Pakistan and the
various periodicals of annual reports of the Federal Board of
Revenue (FBR) Pakistan. The data analysis was performed
using R-software version 4.0.3 (Team, 2020). Descriptive
statistics such as mean, minimum, maximum, frequency,
standard deviation and percentage were used to assess the
multivariate trends in data.

Methods
Firstly, the linear association between tax cuts and tax
revenues was assessed using simple ordinary least squares
 technique. The model is given as:
\[ Rev_t = \alpha_0 + \alpha_1 T_t + \varepsilon_t \]  \hspace{1cm} (1)
Where, subscript ‘\( t \)’ shows the relevant time period (year), \( Rev \)
is the corporate tax revenue as the percentage of GDP, \( \alpha \) is the
intercept term, \( \alpha_1 \) is the slope coefficient of tax rate, \( T \) is
corporate income tax rate and \( \varepsilon \) is the residual term. Model 1
explains how much tax revenue will be increased or decreased
by changing the tax rate to a certain level.

Hsing (1996) constructed four quadratic types of models to
derive Laffer curve for U.S economy: linear model, log-log
model, lin-log model and log-lin model; and found that linear
and log-log models yielded better results as compared to the
semi-log models. Following the literature (Hsing, 1996; Latif
et al., 2019), we estimated Laffer curve using a threshold
regression model. In threshold regression, the predictors are
regressed on the outcome variable in a threshold based
process. When a threshold parameter is incorporated into
regression, the model provides a simple but sophisticated and
more interpretable way to estimate different types of nonlinear
associations between the variables (Pastor-Barruso et al.,
2003). Threshold parameter is also termed as the change point.
Threshold regression model is given below:
\[ Rev_t = \beta_0 T_t + \beta_2 T_t^2 + \varepsilon_t \]  \hspace{1cm} (2)
It is important to mention that the above model is the regression
through origin, i.e., the intercept term has not been included in
the model as it makes no sense. When there is a zero percentage
tax rate, there will ultimately be zero tax revenue (Hsing, 1996).
Following the study of Latif et al. (2019), we also incorporated
the lagged dependent variable (\( Rev_{t-1} \)) in the model in order to
address the problem of autocorrelation. Thus, the threshold
regression model was used in the following form:

\[ Rev_t = \beta_1 T_t + \beta_1 T_t^2 + \alpha_1 Rev_{t-1} + \varepsilon_t \]  

(3)

Stationarity of the data and autocorrelation were tested
through Augmented Dickey Fuller (ADF) test and Durbin
Watson (DW) test, respectively. The outcome models were
compared through AIC and BIC test statistics. The following
hypotheses were postulated based on the objectives of the study:

**Hypothesis 1**
- \( H_0: \alpha_1 = 0 \) (There is no linear association between corporate tax
  rate and direct tax revenue).
- \( H_1: \alpha_1 < 0 \) (There is a negative linear association between
corporate tax rate and direct tax revenue).

**Hypothesis 2**
- \( H_0: \beta_1 = \beta_2 = 0 \) (Laffer curve does not exist in tax system of
  Pakistan).
- \( H_1: \beta_1 > 0 > \beta_2 \) (Laffer curve exists).

### RESULTS AND DISCUSSION

#### Stationarity Diagnosis

Time series data often encounters the problem of non-
stationarity (Griffiths et al., 1993; Gujarati, 2009; Dougherty,
2016). The ADF unit root test results showed that the data was
stationary at level (Table 1).

Figure 1 illustrates the trends of corporate tax rates and tax
revenues as % of GDP in Pakistan. Mostly, the corporate tax
rate remained in the range of 30% to 35%. However, there was
a large jump from 35% in 1999 to 43% in 2000. Correspondingly,
there was a large cut in tax revenue as % of GDP from 3.75% in
1999 to 2.66 in 2000. After 2000, the corporate income tax rate gradually decreased might be due to the reason that the government had realized that tax cuts could increase the tax revenues. The corporate tax revenue (as a % of GDP) has increased gradually over time.

#### Table 1. ADF Test Results.

<table>
<thead>
<tr>
<th>Time Series</th>
<th>Lag order</th>
<th>ADF Test Statistic</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Tax Rate</td>
<td>2</td>
<td>-4.134</td>
<td>0.019</td>
<td>Stationary</td>
</tr>
<tr>
<td>Tax Revenue (% of GDP)</td>
<td>2</td>
<td>-4.279</td>
<td>0.013</td>
<td>Stationary</td>
</tr>
</tbody>
</table>

Note: Alternative hypothesis: Stationary (Source: Authors own calculations).

#### Figure 1. Graphical Illustration of Tax Rates and Tax Revenues in Pakistan (1991-2020).

#### Descriptive Summary

Table 2 presents the descriptive statistics of the data used in the analysis. Results show that from 1991 to 2020, minimum,
average and maximum corporate tax rates in Pakistan were 29,
35 and 43 percent, respectively. Similarly, minimum, average
and maximum tax revenues (% of GDP) were 2.25, 3.31 and
4.44 percent, respectively. The standard deviations for tax rate
and tax revenue were 3.97 and 0.58, respectively.

#### Linear & Non-Linear Models

The results of linear and non-linear models are presented in Table 3. The negative sign of tax rate in linear model depicts that tax cuts
significantly enhanced the tax revenues which confines us to the
conclusion that null hypothesis is rejected in case of the first hypothesis. The R-square value is low in linear model, suggesting
that the model captures only 62% of the variation in response variable due to explanatory variables. Non-Linear model (NLM)-I captures the quadratic relationship between tax rate and tax revenues. The coefficient of tax rate is significantly positive and that of squared tax rate is significantly negative, showing that there exists a level of tax rate where tax revenues are maximized. Hence, we reject null hypothesis in case of second hypothesis. The value of R-square is quite high (0.98) which shows that model is fitted better than the previous one. But, here we encountered the problem of autocorrelation as depicted from DW-statistic 0.746, which is quite significant. Therefore, the lagged dependent variable was included in the model to capture the effect of endogeneity. The signs of estimated parameters are according to the theory (Hsing, 1996; Latif et al., 2019).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minimum</th>
<th>Mean</th>
<th>Maximum</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Tax Rate (%)</td>
<td>29</td>
<td>35.19</td>
<td>43</td>
<td>3.970</td>
</tr>
<tr>
<td>Tax Revenue (% of GDP)</td>
<td>2.25</td>
<td>3.308</td>
<td>4.44</td>
<td>0.578</td>
</tr>
</tbody>
</table>

Source: Authors own calculations.

Table 3. Results of Threshold Regression Models for Laffer curve in Pakistan.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Units</th>
<th>Linear Model</th>
<th>Non-Linear Model (I)</th>
<th>Non-Linear Model (II)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-</td>
<td>35.111 *** (4.03)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T (Tax rate)</td>
<td>%</td>
<td>-0.784 *** (0.11)</td>
<td>0.283 *** (0.02)</td>
<td>0.123 * (0.04)</td>
</tr>
<tr>
<td>T^2</td>
<td>%</td>
<td>-</td>
<td>-0.005 *** (0.001)</td>
<td>-0.002 * (0.001)</td>
</tr>
<tr>
<td>Revt-1</td>
<td>% of GDP</td>
<td>-</td>
<td>-</td>
<td>0.607 *** (0.14)</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td></td>
<td>0.62</td>
<td>0.98</td>
<td>0.99</td>
</tr>
<tr>
<td>F- Statistic</td>
<td></td>
<td>47.40 ***</td>
<td>934.40 ***</td>
<td>971.90 ***</td>
</tr>
<tr>
<td>DW Statistic</td>
<td></td>
<td>0.802 ***</td>
<td>0.746 ***</td>
<td>1.773</td>
</tr>
<tr>
<td>AIC</td>
<td></td>
<td>142.48</td>
<td>37.31</td>
<td>23.22</td>
</tr>
<tr>
<td>BIC</td>
<td></td>
<td>146.68</td>
<td>41.52</td>
<td>28.68</td>
</tr>
<tr>
<td>Threshold (optimal) tax rate (r)</td>
<td></td>
<td>-</td>
<td>26.68 %</td>
<td>25.54 %</td>
</tr>
</tbody>
</table>

Note: SE reported after the coefficients in parenthesis; Significance Codes: ‘***’ = 0.01 ‘**’ = 0.05 ‘*’ = 0.1.

The coefficient of lagged dependent variable is positive and highly significant. The value of DW-test statistic was 1.773 (with p-value 0.122) for NLM-II and the R-square value was also very high. The results confirmed that NLM-II with lagged dependent variable bears the lowest values of AIC and BIC as compared to the other two models. Hence, NLM-II offers the best fit and the most reliable results.

The Laffer curves derived from the NLM-I (smooth curve) and NLM-II (dotted curve) are illustrated in Figure 2 that is sketched on the basis of hypothetical values of tax rates ranging from 0% to 100%. The threshold optimal tax rate is 26.68% for NLM-I, and 25.54% for NLM-II. Currently, Pakistan is operating at 29% corporate tax which is about 3.5% higher than threshold revenue maximizing rate. Similar curves were drawn for the economy of China (Lin and Jia, 2019). The results of quadratic equations support the outcomes of Hsing (1996). The study infers that Pakistan’s corporate tax rate is operating in prohibitive range of the Laffer curve. The research outcomes are also in accordance to those of Latif et al. (2019) which concluded that Laffer curve exists in Pakistan’s tax structure but in the prohibitive area of curve.

During the past two decades, tax to GDP ratio remained very low despite of numerous efforts made by governments, mainly due to the factors such as distortionary tax concessions and exemptions, fragile enforcement of tax laws, non-compliance in paying taxes on a large scale, greater share of indirect taxes as compared to the direct taxes, persistently narrow tax base and weak administration in tax system of Pakistan. There are a few sectors under taxation, many sectors partially taxed and some absolutely not taxed in Pakistan. This unfair distribution and contribution of taxes caused a low tax to GDP ratio and narrow tax base over the history in Pakistan. Levying the high tax rates is not a solution to low tax to GDP ratio but remedying the other pitfalls in the present tax system is crucial.

![Figure 2. Hypothetical Laffer curves for Pakistan's tax system (1991-2020).](image-url)
CONCLUSIONS
The direct (or income) tax has a vital role in sustainability of the economic growth and development of an economy. The study confines to the inference that Laffer curve holds in Pakistan’s tax system. The threshold regression suggested the revenue maximizing tax rates of 26.68% and 25.54% for two separate models, whereas the existing corporate income tax rate in Pakistan is 29% which lies in the prohibitive range of Laffer curve. It is suggested to reduce the corporate income tax rate by about 3% in order to enhance the tax revenues. There is a caution for Pakistan’s economy that our tax to GDP ratio is very low among the other nations of the world. The government may take other appropriate measures to enhance the tax base, thereby bringing the maximum number of tax evaders under the tax net to increase the tax revenues. It is imperative that each citizen of this homeland should meet his or her tax obligation. Support of the whole nation is essential for the success of any initiative of tax reforms and administration. We cannot deny the fact that the tax base should be broadened for improvement in the fiscal position of any country. The government should adopt improved tax policies, thereby ensuring protection for the poor and vulnerable. The economy should be well documented to improve the tax structure and mitigate the fiscal deficit.

Conflicts of Interest
The authors declare no conflict of interest.

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